X5 Frequency Multiplier

RMK-5-51+

50Ω Output 37.5 to 52.5 MHz

CASE STYLE: TT1224

The Big Deal

- High rejection of adjacent harmonics, 50 dBc typ.
- 50 Ω in/out, no tuning necessary
- Very low cost, $19.95 (qty. 10-49)

Product Overview

The RMK-5-51+ is a cost-effective X5 frequency multiplier that utilizes specially selected silicon Schottky diodes and compatible filter circuitry to achieve a low conversion loss, yet have a high rejection of unwanted harmonics near its F5 output. It makes the RMK-5-51+ ideal for a wide range of applications. The tiny plastic case, 0.25” x 0.31” x 0.16” high, is aqueous washable and RoHS compliant.

Feature	Advantages
<23 dB conversion loss	Efficient choice for multiplying a 10 MHz source to 50 MHz output while maintaining reasonable signal power, especially for reference crystal oscillators. Only 13 dBm input required for -10 dBm output for low-loss systems such as instrumentation and ISM.
50 dB rejection of F4 and F6	Proprietary internal circuitry achieves high suppression and minimizes filter requirements for undesired signals, as in wireless Tx/Rx for military applications, aircraft, cordless telephones, remote control, and PMR
Internally balanced to 50Ω in/out, no DC power required	Saves PCB space and simplifies application design, with no external matching or biasing circuits required
Small surface mount package	Easily integrated in systems with minimal PCB area available

Notes
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit’s applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, “Standard Terms”); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits’ website at www.minicircuits.com/MCLStore/terms.jsp

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RMK-5-51+

50Ω Output 37.5 to 52.5 MHz

Generic photo used for illustration purposes only

CASE STYLE: TT1224

+RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	10, 20, 50, 100, 200
13"	500

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Input Power	20 dBm

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

INPUT	1
OUTPUT	4
GROUND	2,3,5,6

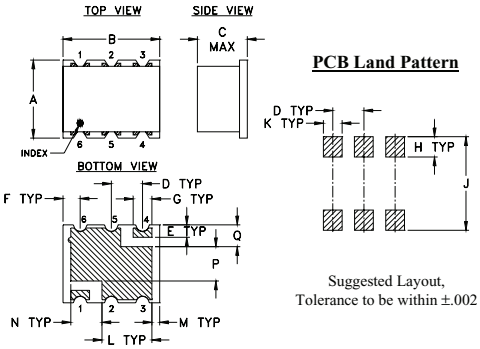
Features

- 5th order multiplication
- high dBc rejection adjacent harmonics
- low cost
- aqueous washable

Applications

- synthesizers
- local oscillators
- satellite up and down converters

Outline Drawing

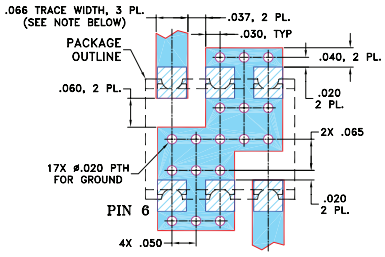


Outline Dimensions (inch / mm)

A	B	C	D	E	F	G	H
.25	.31	.16	.100	.040	.055	.060	.065
6.35	7.87	4.06	2.54	1.02	1.40	1.52	1.65

J	K	L	M	N	P	Q	wt.
.300	.060	.160	.025	.100	.110	.070	grams
7.62	1.52	4.06	0.64	2.54	2.79	1.78	0.16

Demo Board MCL P/N: TB-393
Suggested PCB Layout (PL-258)



NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Electrical Specifications at 25°C

Parameter		Min.	Typ.	Max.	Unit
Multiplier Factor			5		
Frequency Range, Input (F1)		7.5		10.5	MHz
Frequency Range, Output (F5)		37.5		52.5	MHz
Input Power		0	—	5	dBm
Conversion Loss		—	22.9	26	dB
Harmonic Ouput*	F1	-4	-1.3	—	-dBc
	F2	35	43.8	—	
	F3	-10	-6	—	
	F4	28	39	—	
	F6	30	37	—	
	F7	0	4	—	
	F8	32	39	—	

* Harmonics of input frequency below the power level of F5

Typical Performance Data

Frequency Input (MHz)	Frequency Output (MHz)	Conv. Loss (dB) F5	Harmonic Rejection Below F5 (dBc) F1	F2	F3	F4	F6	F7	F8
			at RF Input Power 0 dBm						
7.50	37.50	22.45	5.11	51.91	-1.40	44.41	45.68	7.26	51.16
8.00	40.00	22.13	4.30	51.20	-2.21	44.26	46.39	7.68	53.11
8.50	42.50	21.81	3.47	52.77	-2.90	46.44	49.17	8.03	56.27
9.00	45.00	21.58	2.55	56.05	-3.59	50.48	53.89	8.42	61.44
9.50	47.50	21.55	1.56	73.55	-4.30	73.05	72.21	8.78	76.10
10.00	50.00	21.83	0.42	69.32	-5.08	60.02	61.46	9.24	65.77
10.50	52.50	22.72	-1.29	62.25	-6.22	57.83	60.43	10.31	65.15
			at RF Input Power 5 dBm						
7.50	37.50	22.89	8.33	47.06	0.91	38.25	37.20	3.54	39.00
8.00	40.00	22.51	7.61	46.79	0.22	38.28	37.87	4.07	40.07
8.50	42.50	22.41	6.68	46.52	-0.56	38.45	38.69	4.65	41.32
9.00	45.00	22.36	5.69	47.29	-1.35	39.74	40.62	5.17	43.59
9.50	47.50	22.31	4.75	57.24	-2.05	50.82	53.61	5.50	56.53
10.00	50.00	22.18	3.95	54.02	-2.62	48.61	50.65	5.63	52.87
10.50	52.50	21.88	3.22	44.28	-3.14	38.45	40.91	5.64	43.53

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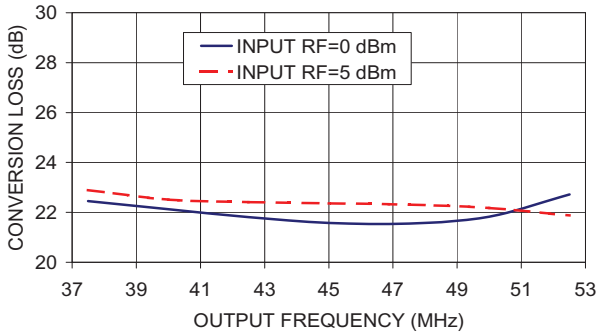
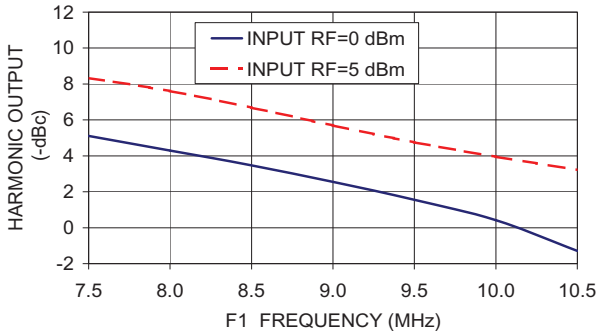
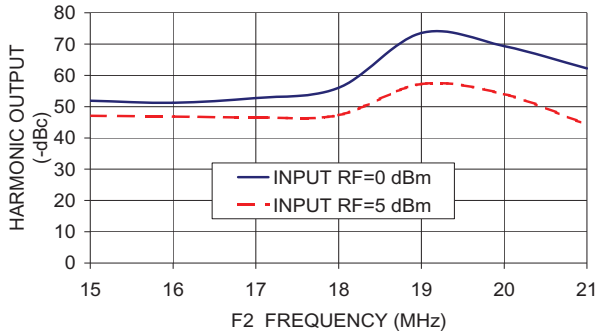
RMK-5-51+
CONVERSION LOSS



RMK-5-51+
HARMONIC OUTPUT F1



RMK-5-51+
HARMONIC OUTPUT F2



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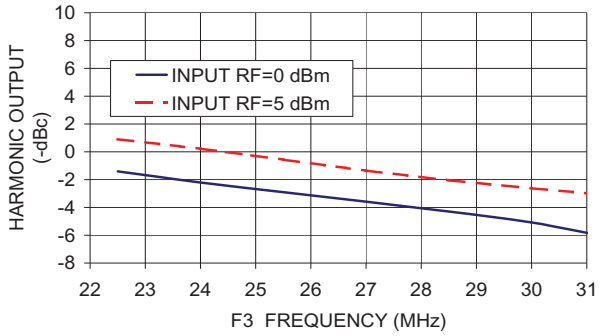
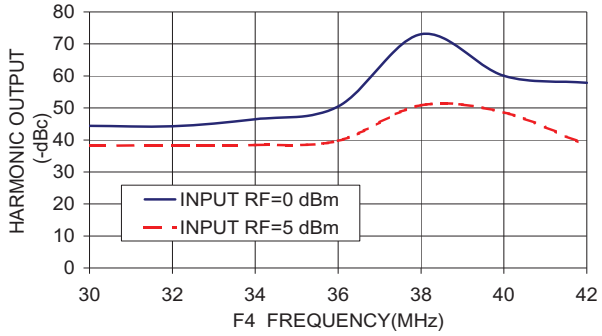
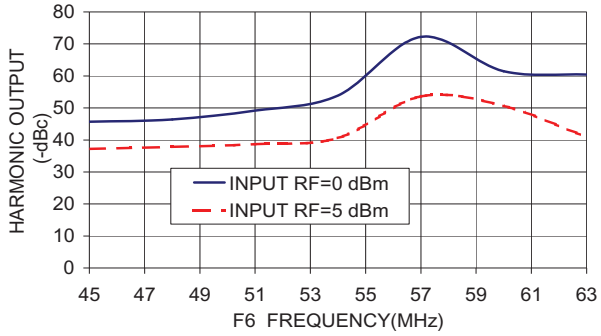
HARMONIC OUTPUT F3



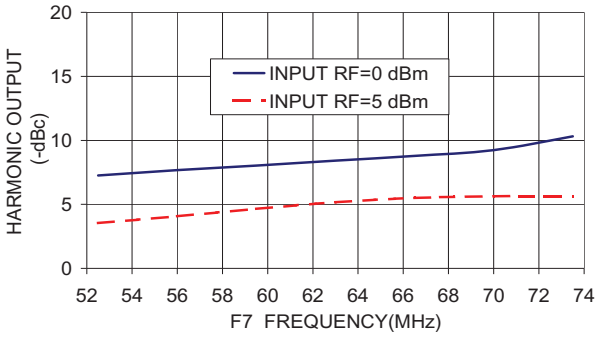
RMK-5-51+
HARMONIC OUTPUT F4



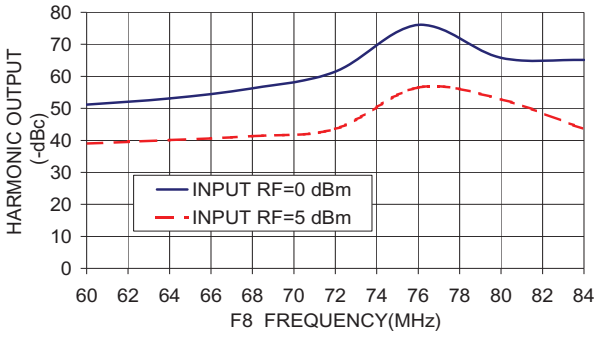
RMK-5-51+
HARMONIC OUTPUT F6



RMK-5-51+
HARMONIC OUTPUT F7



RMK-5-51+
HARMONIC OUTPUT F8



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Frequency Multiplier (X5) RMK-5-51+

Typical Performance Data

FREQUENCY (MHz)								CONVERSION LOSS (dB)	RF IN = 0 dBm HARMONIC OUTPUT* (-dBc)						
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X8 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT	X8 OUTPUT
7.50	15.0	22.5	30.0	37.5	45.0	52.5	60.0	22.45	5.11	51.91	-1.40	44.41	45.68	7.26	51.16
8.00	16.0	24.0	32.0	40.0	48.0	56.0	64.0	22.13	4.30	51.20	-2.21	44.26	46.39	7.68	53.11
8.50	17.0	25.5	34.0	42.5	51.0	59.5	68.0	21.81	3.47	52.77	-2.90	46.44	49.17	8.03	56.27
9.00	18.0	27.0	36.0	45.0	54.0	63.0	72.0	21.58	2.55	56.05	-3.59	50.48	53.89	8.42	61.44
9.50	19.0	28.5	38.0	47.5	57.0	66.5	76.0	21.55	1.56	73.55	-4.30	73.05	72.21	8.78	76.10
10.00	20.0	30.0	40.0	50.0	60.0	70.0	80.0	21.83	0.42	69.32	-5.08	60.02	61.46	9.24	65.77
10.50	21.0	31.5	42.0	52.5	63.0	73.5	84.0	22.72	-1.29	62.25	-6.22	57.83	60.43	10.31	65.15

* Harmonic Output below power level of X5 Output.

Typical Performance Data

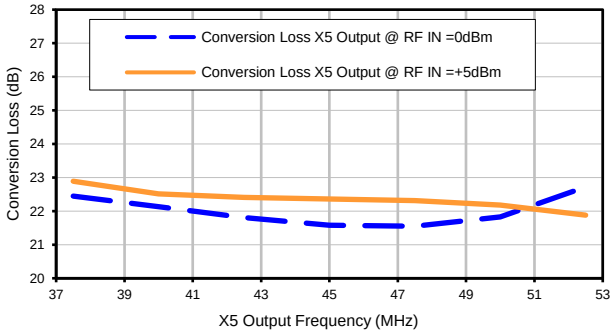
FREQUENCY (MHz)								CONVERSION LOSS (dB)	RF IN = +5 dBm HARMONIC OUTPUT* (-dBc)						
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X8 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT	X8 OUTPUT
7.50	15.0	22.5	30.0	37.5	45.0	52.5	60.0	22.89	8.33	47.06	0.91	38.25	37.20	3.54	39.00
8.00	16.0	24.0	32.0	40.0	48.0	56.0	64.0	22.51	7.61	46.79	0.22	38.28	37.87	4.07	40.07
8.50	17.0	25.5	34.0	42.5	51.0	59.5	68.0	22.41	6.68	46.52	-0.56	38.45	38.69	4.65	41.32
9.00	18.0	27.0	36.0	45.0	54.0	63.0	72.0	22.36	5.69	47.29	-1.35	39.74	40.62	5.17	43.59
9.50	19.0	28.5	38.0	47.5	57.0	66.5	76.0	22.31	4.75	57.24	-2.05	50.82	53.61	5.50	56.53
10.00	20.0	30.0	40.0	50.0	60.0	70.0	80.0	22.18	3.95	54.02	-2.62	48.61	50.65	5.63	52.87
10.50	21.0	31.5	42.0	52.5	63.0	73.5	84.0	21.88	3.22	44.28	-3.14	38.45	40.91	5.64	43.53

* Harmonic Output below power level of X5 Output.

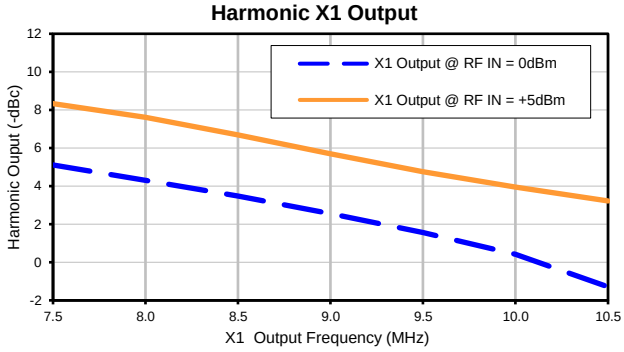
Frequency Multiplier (X5) RMK-5-51+

Typical Performance Curves

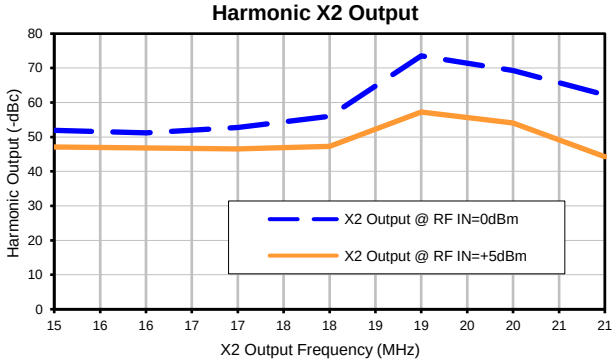
Conversion Loss X5 Output



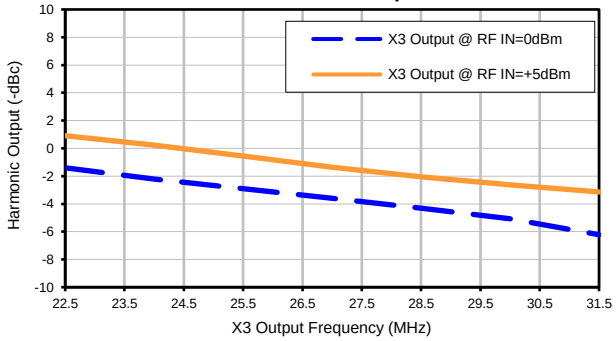
Harmonic X1 Output



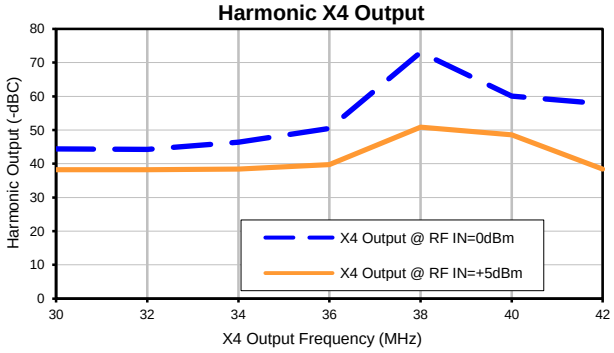
Harmonic X2 Output



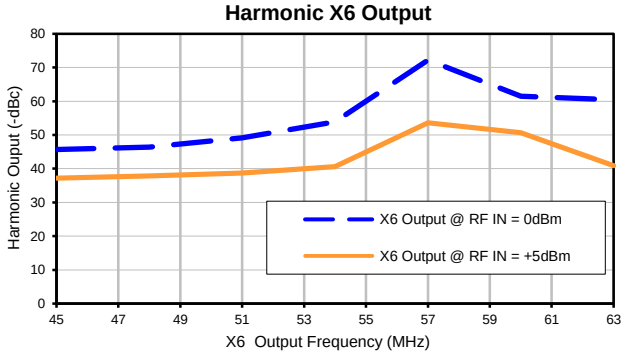
Harmonic X3 Output



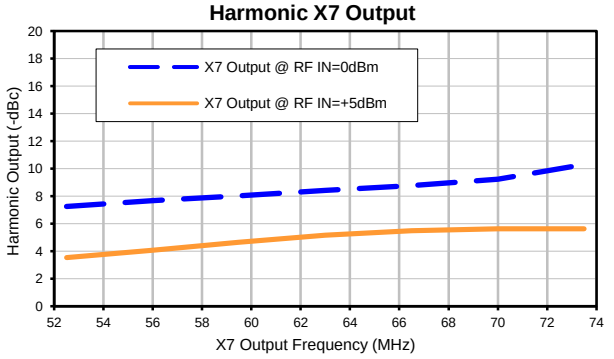
Harmonic X4 Output



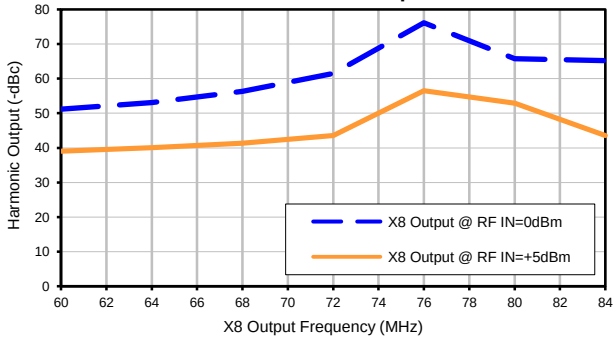
Harmonic X6 Output



Harmonic X7 Output



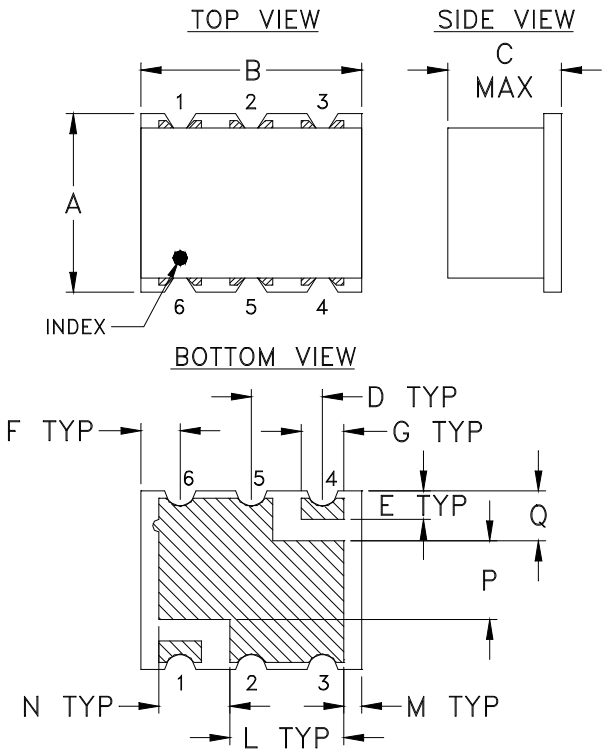
Harmonic X8 Output



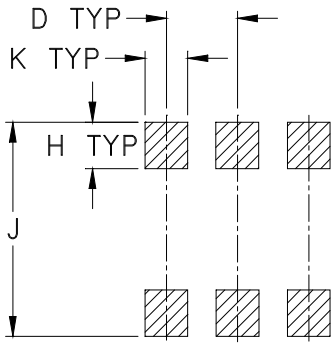
Case Style TT

TT1224

Outline Dimensions



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #	A	B	C	D	E	F	G	H	J	K	L
TT1224	.25 (6.35)	.31 (7.87)	.16 (4.06)	.100 (2.54)	.040 (1.02)	.055 (1.40)	.060 (1.52)	.065 (1.65)	.300 (7.62)	.060 (1.52)	.160 (4.06)

CASE #	M	N	P	Q	WT. GRAM
TT1224	.025 (.64)	.100 (2.54)	.110 (2.79)	.070 (1.78)	.16

Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .005

Notes:

1. Case material: Plastic.
2. Termination: 2-10 µ inch (.05-.25 microns) Gold over 100-300 µ inch (2.54-7.62 microns) Nickel plate

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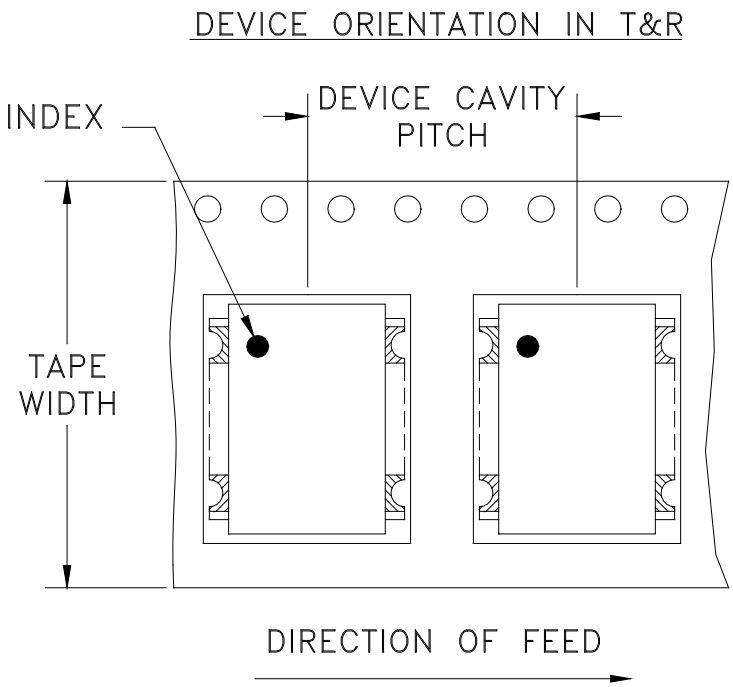
Tape & Reel Packaging TR-F2



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel See note
16	12	7	10
			20
			50
			100
			200
		13	500
			1000

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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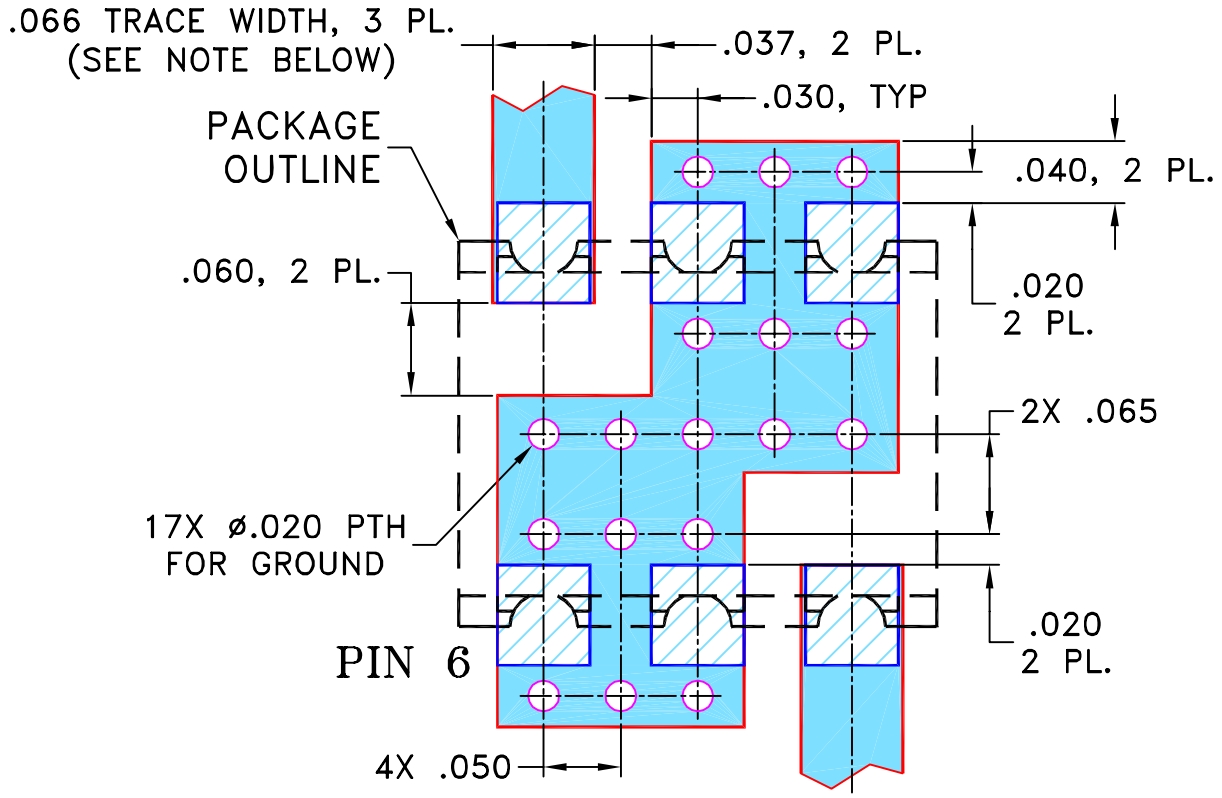
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M108897	NEW RELEASE	01/04/07	AV	DJ

SUGGESTED MOUNTING CONFIGURATION FOR TT1224 CASE STYLE "rv" PIN CONNECTION



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2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	AV	12/14/06
TOLERANCES ON:	CHECKED	IL	01/04/07
2 PL DECIMALS ±	APPROVED	DJ	01/04/07
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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ASHEETA1.DWG REV:A DATE:01/12/95

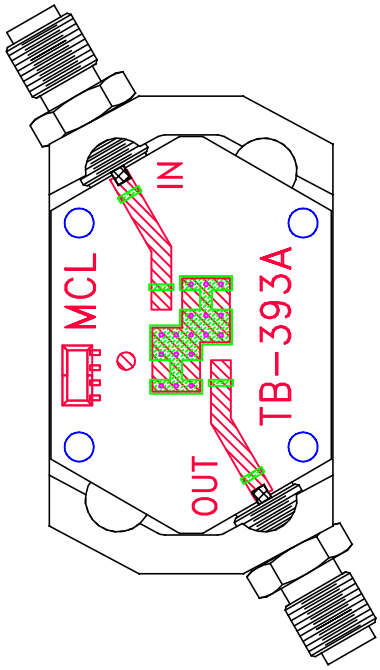
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

PL, rv, TT1224, RMK-3-662+, TB-393

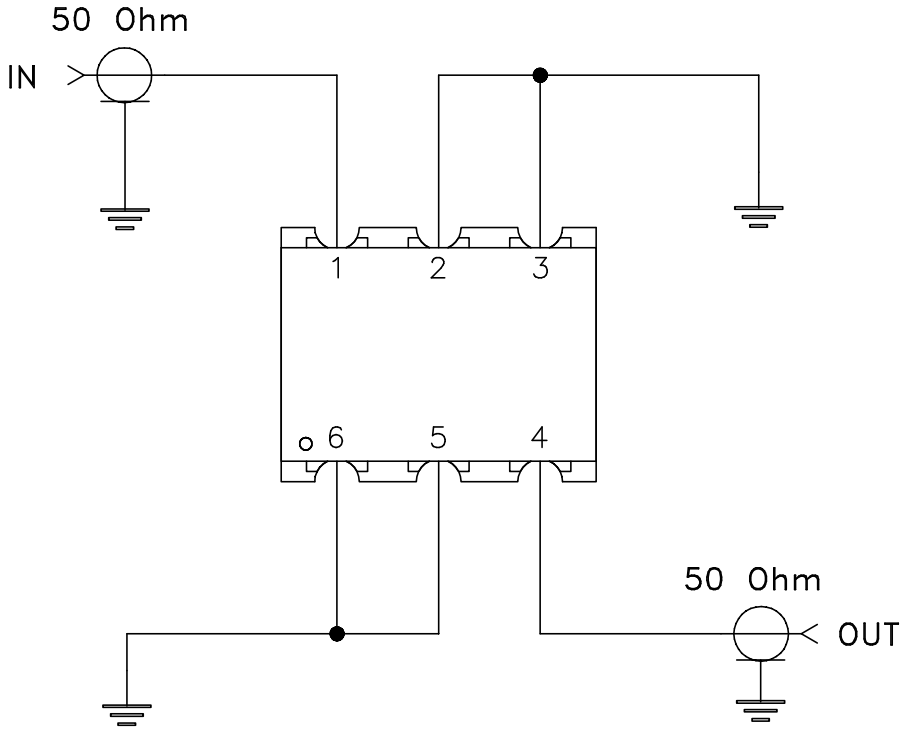
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-258	OR

FILE:	SCALE:	SHEET:
98PL258	8:1	1 OF 1

Evaluation Board and Circuit



TB-393



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

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Environmental Specifications ENV02T1

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutetic Process: 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, 95% Coverage
Vibration (High Frequency)	20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215

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